A new *Stramentum* (Cirripedia) from the Lower Turonian of Nigeria

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Synopsis

A new species of pedunculate cirripede, *Stramentum inconstans*, is described from the Lower Turonian of Lokpanta, south-eastern Nigeria, and comparisons are made with allied species. It represents the second member of the genus to be described from the continent of Africa and considerably extends the known range of the genus southwards.

Introduction

As defined by Withers (1935), the Stramentidae comprised the genera *Loriculina* Dames, 1885, *Stramentum* Logan, 1897 and *Squama* Logan, 1897. Both Withers (1935) and Hattin (1977) were of the opinion that *Squama* was founded on somewhat questionable material, now lost, and Hattin (1977), in his intensive study of the family, concluded that this genus 'is fiction, and that Logan was dealing only with some incomplete, poorly preserved specimens of *Stramentum*'. Hattin (1977) also redefined the generic status of both *Stramentum* and *Loriculina*.

The cirripedes recently discovered by Dr P. M. P. Zaborski (formerly of the University of Ilorin, Nigeria) in the Eze-Aku Formation of the Lower Turonian at Lokpanta, south-eastern Nigeria, meet the requirements of the genus *Stramentum* as now defined. The new species represents the second member of the genus to be described from the African continent and considerably extends the geographical range of the family southwards.

Of the nine species of *Stramentum* hitherto recognized (Hattin 1977), the earliest geologically, *S. saadensis* Davadie & Emberger 1954 (described from incomplete specimens from Libya), *S. texanum* (Withers 1945) and *S. syriacum* (Dames 1885) are from the Albian. *S. moorei* Hattin 1977 and *S. pulchellum* (G. B. Sowerby, jr 1843) are known from the Cenomanian and the latter ranges into the Turonian. Also of Turonian age are *S. canadensis* (Whiteaves 1889) and *S. elegans* Hattin 1977. The remaining species, *S. expansum* (Withers 1935) and *S. haworthi* (Williston 1897) are both from the Senonian.

Stratigraphy

At the type locality, the Eze-Aku River, near Ake-Eze, eastern Nigeria, the Eze-Aku Shale of Simpson (1955) consists of some 100 m of hard grey to black shales and siltstones with local facies changes to sandstones or silty shale. On the evidence of numerous vascoceratid ammonites Reyment (1965) considered this deposit to be of Turonian age. The ammonites probably floated into the area of deposition as dead shells, for the accompanying fauna which includes bivalves, gastropods, echinoids and fish teeth indicates a shallow water deposit.

Kogbe (1976) cast some doubt on Reyment's (1965) opinion that there was a connection between the Gulf of Guinea and the Mediterranean Sea during lowermost Turonian times, by saying that there was no definite evidence from the Sahara and North Africa to support it. As remarked below, p. 130, *S. inconstans* sp. nov. has affinities to the Cenomanian–Turonian species *S. pulchellum*, described from southern England, Ireland and Czechoslovakia, and it seems probable that the new species developed from that stock migrating southwards, rather than from the earlier *S. saardensis*.

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Preservation and Substrates

The substrates of the specimens here examined consist of three pieces of fragmentary inner casts of acanthoceratid ammonites. Two of these pieces have cirripedes on both sides, indicating that the pieces themselves were lodged in a more or less upright position. In all but one instance the cirripedes, of which three or four distinct generations are present, are orientated in the same direction—whether on the 'left' or 'right' side of the substrate—presumably aligned so as to obtain best advantage of the currents regulating food supply.

Evidently the colonies were rapidly overwhelmed by sediment, for comparatively little disturbance of the valves has occurred. Indeed, so complete are the specimens that the description is impaired to some extent by the absence of isolated valves which would show the inner surface characters. There are one or two somewhat dispersed groups of plates and in one instance a capitulum has been sheared and displaced several mm from an otherwise undisturbed peduncle. The holotype and one other specimen have suffered the loss of peduncular plates in the median (i.e. upper lateral) column; in the holotype three plates beneath the first (fully grown) plate are missing and in In.62056 three plates are missing below the third plate and the previous three plates are compacted. That these losses were early is indicated by partial infilling of the resultant cavities, but no reason for them can yet be given.

Other *Stramentum* species attached to ammonites have been reported by Withers (1935, 1945) and Davadie & Emberger (1954). Besides cephalopods Hattin (1982: 75–76) listed other substrates occupied by *S. haworthi* (often in association with a minute scalpellid cirripede, *Zeugmatolepas* sp.) which included such truly benthonic forms as *Inoceramus* (*Volviceramus*) *grandis* (Conrad), *I.* (*Platyceramus*) *platinus* Logan and, rarely, *Pseudoperna congesta* (Conrad), oysters and rudists. From this Hattin (1982) concluded that the cirripedes themselves had a benthonic existence, rather than the pseudo-pelagic one as suggested by Miller (1968), and that those attached to ammonites had settled only on empty shells lying on the sea floor.

Systematic descriptions

The skeletal nomenclature adopted in this work follows Hattin (1977). All the material is in the Department of Palaeontology, British Museum (Natural History).

Class **CIRRIPEDIA** Burmeister, 1834

Order **THORACICA** Darwin, 1851

Suborder **LEPADOMORPHA** Pilsbry, 1916

Family **STRAMENTIDAE** Withers, 1920

Genus ***STRAMENTUM*** Logan, 1897

1897 *Stramentum* Logan: 188.
1920 *Stramentum* Logan; Withers: 69.
1935 *Stramentum* Logan; Withers: 311 (q.v. for intermediate synonymy).
1977 *Stramentum* Logan; Hattin: 807.

DIAGNOSIS. Stramentids having scutum with subapical, commonly subcentral umbo. Individual plates in peduncular column beneath upper latus markedly imbricated with plates of adjacent columns.

TYPE SPECIES. *Pollicipes haworthi* Williston, 1896, by subsequent designation of Withers, 1920.

RANGE. Albian to Senonian.

Stramentum inconstans sp. nov.
Figs 1–4

DIAGNOSIS. A species of *Stramentum* with the scutum elongate-trapezoidal, the upper lateral margin and basal margin forming an angle of about 119°, and with umbo set between 0·75 to

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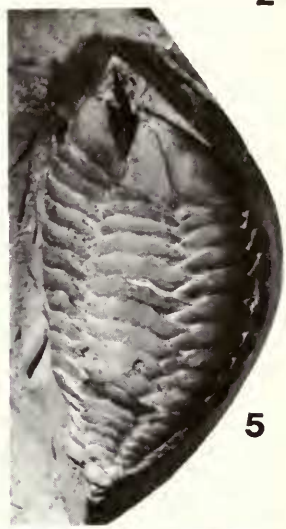

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Figs 1–4 *Stramentum inconstans* sp. nov. Lower Turonian, Eze-Aku Formation, Lokpanta, south-eastern Nigeria. Fig. 1, several complete individuals of various ages, showing right side uppermost, attached to an acanthoceratid ammonite. The holotype, In.62053, see also Fig. 4, is on the extreme left. × 1·5. Fig. 2, a group of partially displaced valves showing inner occludent edge of two right scuta, In.62059. × 1. Fig. 3, a very young complete individual, In.62054. × 5. Fig. 4, **holotype**, In.62053, showing peduncular plates missing from the upper lateral column, and the displaced edge of a valve against the carinal margin. × 3.

Fig. 5 *Stramentum pulchellum* (G. B. Sowerby jr). Turonian, *R. cuvieri* Zone; Cuxton, near Rochester, Kent. Holotype, individual with left side uppermost and carina and tergum missing. (G. B. Sowerby jr 1843; Withers 1935: pl. 41, fig. 4). BM(NH) 59150.

0·40 of distance from the apex to the rostral angle. Tergum with growth lines straight. The occludent margin is inflected in adults, less so in juveniles. The peduncular height ranges from about 3·10 to 3·80 times the height of the capitulum at the carinal margin, averaging 3·70. The peduncle is widest about midlength; the plates in the rostral column are about twice the width of those in the carinal column; the uppermost plates in the paired columns are more than twice as wide as high and those in the upper lateral column are variable in outline.

NAME. Alludes to the irregular size and form of the peduncle plates in the upper lateral column.

HOLOTYPE. A more or less complete skeleton, In.62053, on a fragment of an acanthoceratid ammonite (Figs 1, 4). Lower Turonian Eze Aku formation exposed in a road cutting on the Enugu–Port Harcourt express way at Lokpanta, south-eastern Nigeria.

MATERIAL. Besides the holotype there are 8 paratypes, In.62054–In.62061, of which In.62054-58 are on the same substrate as the holotype. In.62059-60 and In.62061 are on two similar but smaller ammonite fragments from the same horizon and locality.

DESCRIPTION. The height of the skeleton is approximately 1·5 times its greatest width. The junction of the capitulum to the peduncle is normally oblique from the carinal margin as far as the scutum, where it becomes straight to the rostral margin, the angle of incidence to the perpendicular height being about 34° in adults and somewhat less in juveniles. The peduncle is widest about midlength, and generally rather more boldly curved on the rostral side than on the carinal side where the bulge occurs further from the capitulum. The uppermost peduncular plate in the carinal lateral and upper lateral columns overlaps the base of the corresponding capitular valves, but as often as not the base of the scutum is left uncovered. The outer surface of the valves is generally glossy and devoid of longitudinal ridges; the normally inconspicuous growth lines are closely spaced apically, becoming less so towards the base; the leading edge of each ridge is slightly turned towards the apex. In some instances of more vigorous growth these ridges are broader and spaced much further apart, giving the surface a rippled appearance.

Scutum almost isosceles-triangular in juveniles, progressing to elongate-trapezoidal in adults, the maximum width generally a little less than half the height. The occludent margin is distinctly inclined towards the carinal side. The umbo is situated from 0·75 to 0·40 of the distance from the apex to the rostral angle and the umbonal angle ranges from about 109° to 123°, averaging 115°. There is sometimes a shallow excavation above the umbo, after which the occludent margin is nearly straight, or gently convex in more angular valves, to the apex; below the umbo it is gently convex. The rostral angle is rounded. The basilateral angle is not so rounded in adults, causing the basal margin to be straighter than in juveniles. The lateral margin is almost straight, but opposite the umbo it may be inflected obliquely towards the apex. No ridge is developed from the umbo to the basilateral angle; on the occludent side the surface is well rounded towards the margin, where only a narrow rostral slip can be determined; it then becomes flatter as far as the basilateral angle and then depressed to slightly excavate to the lateral margin, the excavation being limited above by a thickening divided by a thin groove along the upper occludent margin.

Part of the inner surface, revealed on In.62059 (Fig. 2), shows a trough (the occludent facet of Hattin, 1977), up to one third of the valve's width, extending parallel to the occludent margin; at the apex it is bounded for one third of its length by a conspicuous ridge which incurves and becomes obsolete basally. Within the trough the growth lines curve upwards from the occludent edge and become progressively more looped towards the base. Shortly below the apex on the lateral side there is a glimpse of the adductor muscle pit.

Rostrum. Seen only in lateral view, this reaches from about one quarter to one third the scutal height. It overlaps the basiscutal margin and extends about one third of the scutal width; its inner, scutal, margin is somewhat more strongly curved than its outer which, for the most part, follows the curve of the peduncle margin.

Upper latus nearly flat and triangular. The length of the basal margin is from 0·75 to 0·875 the length of the scutal margin; in height it reaches, or extends marginally beyond, the apex of the scutum. The apical angle is between 49° and 61°, averaging 55°. The straight to gently convex scutal margin is slightly longer than the tergal margin, which is nearly straight. The basitergal angle is only a little more rounded than the basiscutal angle, neither conspicuously so. The growth lines follow the almost straight basal margin; along the tergal margin they turn abruptly towards the apex within the limited arc of the basitergal angle.

Tergum subtriangular in outline, transversely flattened from the carinal lateral margin to a 'line' (rarely developed as a rounded ridge, e.g. in In.62058) from apex to the occludent upper lateral angle, and then rounded to the occludent margin. The apex is acute and level with that of the carinal latus; the apical angle averages about 38°. The nearly straight carinal lateral margin is the longest and forms an angle of about 62° with the upper lateral margin which is nearly straight to gently convex. The occludent upper lateral angle may be rather narrowly or broadly rounded; this in turn affects the development of the occludent margin.

Carinal latus elongate triangular in outline, height about twice the basal width with the apical angle about 32°. Transversely it is nearly flat, becoming narrowly rounded towards the carinal margin. The tergolateral margin is the longest and is almost straight to slightly convex, the convex part being generally more noticeable apically. The nearly straight basal margin forms almost a right angle with the carinal margin. The growth lines follow the basal margin and turn up with the arc of the slightly rounded basal angle to form a narrow tergal slip; the growth lines on the tergal slip correspond with those on the tergum.

Carina. Seen only in lateral view, this reaches the apex of the tergum; it is bowed slightly inwards and tapers gradually from the apex to the basal margin. It is about five times as high as its basal depth.

In the holotype (In.62053) the carinal margin of the carinal latus on the obscured side projects fractionally and lies parallel to the outer margin of the carina. An apparently similar condition observed by Wyville Thomson (1858) in his *Loriculina macadami* (= *Stramentum pulchellum* (G. B. Sowerby jr)) led him to assume that the projecting capitular margin formed the inner edge of a carina naturally split longitudinally along the midline. Withers (1935) upheld this opinion and, furthermore, considered the presence of a split carina one of the important characters distinguishing *Stramentum* from *Loriculina.* This distinction, maintained by Newman *et al.* (1969), was dispelled by Hattin (1977) after a critical examination of Wyville Thomson's specimen revealed that the stramentid carina was typical of those of other lepadomorph barnacles.

Peduncle. Withers (1935: 302) presumed that the peduncle was comprised of five columns of overlapping plates on each side of the capitulum, the columns consisting of three rows of large plates lying under the scutum, upper latus and carinal latus respectively, with a smaller column along the carinal margin and another along the rostral margin. The two smaller columns were said to be in free apposition to the adjacent larger columns. From a study of peduncles belonging to several North American species of *Stramentum,* Hattin (1977) has conclusively demonstrated that the 'paired marginal columns', as formerly considered, consist only of a single column and that 'the stramentid peduncle consists of a single column of peduncular plates beneath each capitular plate and extends to the base of the capitulum'.

In the present species there is normally one more plate at the summit of the peduncle on the carinal and carinal lateral columns than on the rostral and scutal columns. The plates in the rostral and carinal columns are seen only in lateral view and those in the rostral column are about twice the width of those in the carinal column. Uppermost plates in the paired columns are three to four times as wide as high. The uppermost plates in the rostral column are about as wide as high with the rounded apex markedly overlapping the base of the plate above; in juveniles the plates are more quadrate and there is less overlap at the apex. The produced lower scutal angle is overlapped by the scutal plate of the preceding whorl.

The uppermost carinal plates are almost quadrangular, slightly higher than wide and a little less than half as wide as the corresponding plates in the adjacent column. They are slightly convex on the outer margin and correspondingly concave on the inner margin where the basal angle is very slightly produced.

Of the paired columns the scutal plates are broadly trapezoidal, about twice as wide as high and rather more truncate on the rostral side; on the upper lateral side they are produced to a spur which overlaps the adjacent plate in the upper lateral column.

The upper lateral column plates are widest and subject to greatest variation according to their position relative to the curvature of the peduncle. At their widest the plates are four to five times as wide as high and about twice the width of those adjacent in the carinal column. The upper margin of the basal plates is very rounded to arcuate; it flattens as the width increases, becoming almost undulate and rather more attenuated on the carinal side. The narrower plates just below the capitulum are somewhat higher, have almost straight upper margins and are only a little wider than those on either side.

Plates in the uppermost whorls of the carinal lateral column are trapezoidal, with the lower lateral angle slightly produced; this angle decreases rapidly and the baseline increases correspondingly to accommodate the greater curve on the carinal side of the peduncle.

Discussion. In general appearance *Stramentum inconstans* most closely resembles *S. pulchellum* (G. B. Sowerby jr), but the latter differs in having a more smoothly rounded occludent margin and the scutal umbo is placed further from the apex; also the plates in the paired peduncular columns are more nearly equal in width, while those in the upper lateral column are altogether straighter and more regularly developed. Much the same can be said of the Senonian *S. haworthi* (Williston), but in this species the scutum is quadrangular, the carinal latus is less elongate, i.e. wider in proportion to length, and the upper lateral plates are, if anything, rather narrower than those adjacent.

S. elegans Hattin and *S. canadensis* (Whiteaves) have a longer capitulum in relation to overall length and the widest part of the peduncle occurs adjacent to the capitulum; the junction itself is more or less continuously oblique, not straightened below the scutum as in *S. inconstans*; and the scutum is distinctly arcuate at the umbo causing a much sharper inflexion to the occludent margin. *S. expansum* (Withers) is known by a single scutum which differs in the more central position of the umbo, and in the basilateral and rostral angles being almost right angles.

The capitulum of *S. saardensis* is poorly preserved, but according to Davadie & Emberger (1954) it occupied one fifth of the length of the skeleton. The widest part of the peduncle appears to be a little anterior to midlength and although the lower plates of the upper lateral column have a convex upper margin they quickly flatten; compared to those of *S. inconstans* they are higher than wide, more nearly equal in width to those in the adjacent columns and each plate is not nearly so tapered at the lateral angles.

The terga of *S. texanum* (Withers), *S. syriacum* (Dames) and *S. moorei* Hattin all have V-shaped growth lines, and by this character are immediately distinguishable from that of *S. inconstans* in which the growth lines are parallel to the basal margin. Should better preserved specimens of *S. saardensis* show it to have terga with similar V-shaped growth lines, then that species would display a more direct relationship with *S. syriacum* to the east and *S. texanum* (and the later *S. moorei*) to the west.

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